

**2.1 BACKGROUND OF PROGRAM ELEMENTS**

The Cool Roofs program element, funded through California Assembly Bill 970 (AB 970), and the Cool Savings program element, funded from Senate Bill 5X (SB 5X), provide incentives to participants for the installation of Energy Commission-approved ENERGY STAR® rated cool roofing products and, in some cases, thermal insulation to reduce buildings' peak electricity demand. The Cool Roofs program was initiated under AB 970 with funds of \$9.4 million. The Cool Savings program, an extension of the AB 970 initiative that targets primarily flat or low-sloped commercial and industrial roofs added \$14.5 million in funding.

These program elements promote the installation of ENERGY STAR® rated cool roofing products that reduce solar energy absorption by rooftops and rooftop ducts. Cool roofing products lower roof temperatures, decreasing heat transfer into the building thereby reducing air conditioning loads. Cool roofing materials are defined in these programs as those materials with a solar reflectivity greater than 65 percent and an emissivity greater than 80 percent-for flat and low-sloped roofs, and a solar reflectivity greater than 40 percent and an emissivity greater than 80 percent--for high profile tiles on sloped roofs.

The program element consists of Energy Commission contracts with five regional program administrators, who have a combined demand savings goal of approximately 40 MW. The program administrators are directly responsible for: promoting the program, enlisting participants, verifying project eligibility and completion, and paying incentives. Administrators are also responsible for reporting on the progress of their programs to the Energy Commission. The five program administrators are:

1. Local Government Commission (LGC)
2. Los Angeles Department of Water and Power (LADWP)
3. Sacramento Municipal Utility District (SMUD)
4. The Sacramento Tree Foundation (STF)
5. San Diego Regional Energy Office (SDREO)

**2.2 STATUS OF PROJECT ELEMENT**

As of December 31, 2002, under both the AB 970 and SB 5X-funding sources, Nexant has verified the complete installation of about 33 million square feet of cool roofing materials, representing about 11 MW of verified demand savings. Based on current program enrollment, Nexant expects that, by April 2003, the programs will have delivered about an additional 7.5 MW in verified savings. Since program administrators are continuing to enlist participants, these additional verified savings could be greater.

Of the 7.5 MW, 2.0 MW have already been installed. However, according to Nexant's latest records, program administrators have not yet invoiced these to the Energy Commission. The remaining 5.5 MW represents approved projects that are pending installation. Once the projects are installed, the incentives for these projects will be invoiced to either AB 970 or SB 5X-funds, depending on the funds available, project timing, and project type.

Table 2-1 shows the verified peak savings attributed to the AB 970 and SB 5X-funded elements, current as of December 2002. The table also shows the estimated savings for projects that have been completed but not yet invoiced to either AB 970 or SB 5X-funding source. Finally, the estimated savings for projects with approved contracts that are pending completion are also listed.

**Table 2-1: Total Verified and Estimated Demand Savings**

<b>Project Category</b>	<b>Savings (MW)</b>
AB 970 verified	5.1
SB 5X verified	5.8
Complete, not invoiced—Estimated for AB 970 and SB 5X	2.0
Contracted, pending completion—Estimated for AB 970 and SB 5X	5.5
<b>Total</b>	<b>18.4±3.6</b>

Figure 2-1 illustrates trends in program activity since the program began. The graph shows that cool roofing installations and total participants both grew at a fairly steady pace. The installed roofing averaged approximately 0.6 MW of new cool roofs every month with the number of participants growing approximately 0.9 MW per month. New enrollment, projects dropping out, or being disqualified affected the number of approved projects, and installations completed; therefore, these projects have had more fluctuation in growth. The reported savings from approved projects grew at an average of around 0.3 MW per month.

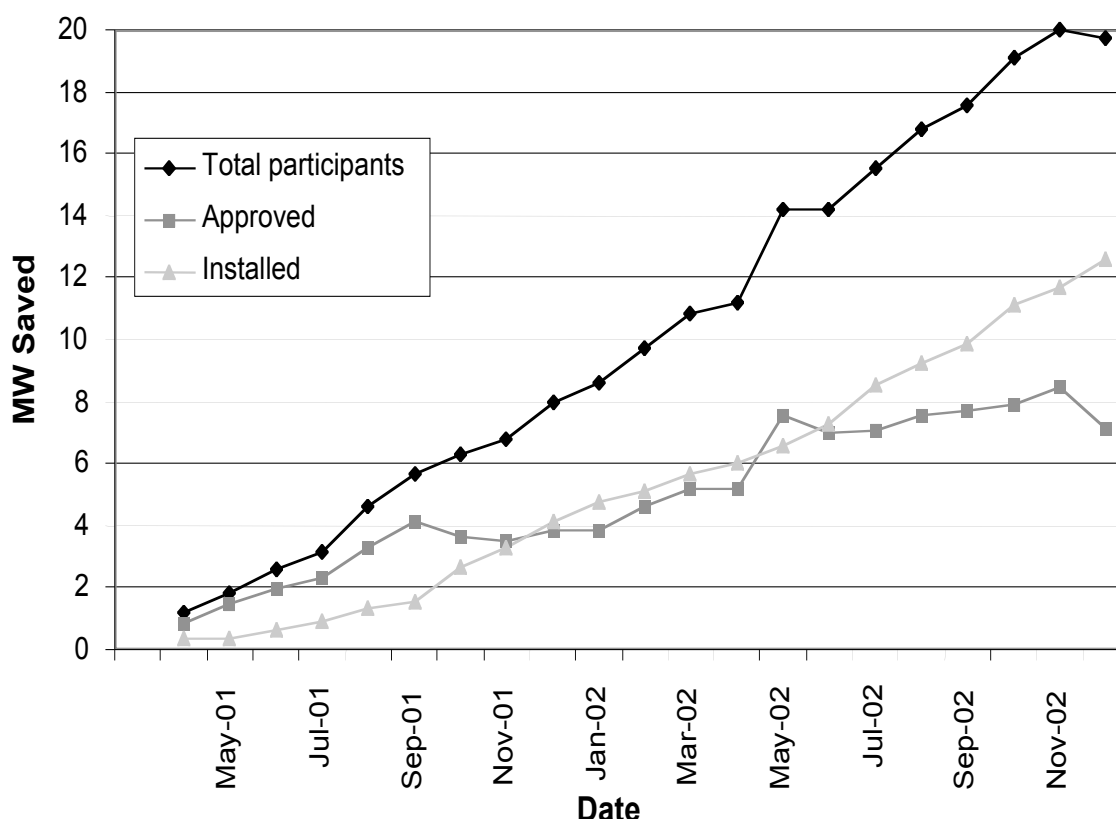
**Figure 2-1: Program Activity over Time**

Table 2-2 shows the program accomplishments for each administrator in terms of roof area (combined contracted and installed), the number of sites, and demand savings (combined verified and estimated). The LGC is not listed in these and following tables because they are involved with the promotion of the Cool Savings program and most of their savings are credited to STF and SDREO.

**Table 2-2: Projects Completed/Approved by December 31, 2002**

Program Administrator	Total Estimated Roof Area (sq ft)	Number of Sites	Total Estimated Savings (MW)
LADWP	2,641,985	214	0.92
SMUD	5,021,221	202	1.62
STF	21,863,748	939	7.14
SDREO	25,626,339	903	8.74
<b>Total</b>	<b>55,153,293</b>	<b>2,258</b>	<b>18.42 MW</b>

## 2.3 MV&E APPROACH

Nexant's approach to verifying the savings for this program, for both the AB 970 and SB 5X-funding source, involved collecting project data reported by program administrators to the Energy Commission, selecting a sample of projects for which to perform measurements and verify demand savings, performing the measurements and savings calculations for the sample selected, and extrapolating the results from the sample to the entire program population.

Each month, the program administrators sent program databases to the Energy Commission, who, forward those databases to Nexant. The measurement and verification activities were based on the database information forwarded to Nexant.

The program administrator databases contained fields for data from participant applications such as: site location, participant contact information, building type, roof and duct square footage, number of stories, indoor temperature, type of HVAC system, previous and new roofing material, type of roof construction, insulation levels, roofing contractor information, and rebate amount.

The databases also included fields for administrator data such as: dates of requests for information, applications, approvals, installations, invoices sent to the Energy Commission or LGC, and payments made to participants. There were also fields for pre- and post-installation administrator inspection data such as reflectivity and roof and duct square footage, and fields for estimated and actual incentive amounts.

Nexant segmented the total population of projects in the administrator databases into four subpopulations—one for each of the program administrators (except LGC). From each subpopulation, Nexant randomly selected a sample of projects; each sample selection was large enough to meet the Energy Commission's requirements for confidence and statistical precision. For the SB 5X program element, Nexant again segmented the total population of projects, this time by building type (industrial, retail, office, etc.). For each of these sub-populations, Nexant calculated the sample size necessary to meet the program requirements for statistical validity. If there were not enough projects of a particular building type in the administrator sample population, Nexant randomly selected more projects of that building type and added those projects to the administrator sample population. In this way, Nexant derived a statistically valid sample population that was representative of the entire SB 5X program population.

For the AB 970-funded element, Nexant also segmented the population into various subpopulations. For a detailed discussion of the AB 970 sampling approach, please refer to Nexant's website, <http://www.nexant.com/services/cec>.

Table 2-3 shows the breakdown of sample populations by administrator and by program element. LADWP's population size is smaller than that of SMUD because of delays in reporting.

**Table 2-3: Sample Populations by Program Administrator**

<b>Program Administrator</b>	<b>Total Sites Contracted</b>	<b>AB 970 Sample Size</b>	<b>SB 5X Sample Size</b>	<b>Total Sample Size</b>
LADWP	214	4	9	13
SMUD	202	9	12	21
STF	939	19	21	40
SDREO	903	19	28	47
<b>Total</b>	<b>2,258</b>	<b>51</b>	<b>70</b>	<b>121</b>

Table 2-4 shows the breakdown of the SB 5X-funded sample population by building type.

**Table 2-4: Sample Populations by Building Type (SB 5X Only)**

<b>Building Type</b>	<b>Total Sites Invoiced</b>	<b>Sample Size</b>
Cold storage	16	8
Multifamily	77	9
Industrial	15	10
Office	217	10
Other	98	10
Retail	120	10
Schools	208	13
<b>Total</b>	<b>751</b>	<b>70</b>

## 2.4 PROGRAM ELEMENT MONITORING AND VERIFICATION

Program administrators and Nexant used deemed savings values to calculate estimated and verified demand savings. The deemed savings values were derived from research performed by Lawrence Berkeley National Laboratory and approved by the Energy Commission.

In SB 5X the demand savings were calculated by multiplying roof area in square feet by 0.35 watts per square foot (the deemed savings rate). In AB 970, the roof area in square feet was multiplied by one of three deemed rates, depending on the thermal resistance as R-value of the roof. The three AB 970 deemed savings rates were 0.4, 0.3, and 0.2 watts per square foot. More details on the AB 970 approach to savings calculations can be found in Nexant's 2001 program report.<sup>1</sup>

Nexant visited each site in the sample populations to verify the installation of the cool roofing materials and to measure the roof area. Although only the roof area measurements were used to calculate verified demand savings, Nexant also collected data on roof reflectivity with the albedometer and the size and age of existing air conditioner units. Analyses of those findings are presented later in this section.

<sup>1</sup> <http://www.nexant.com/services/cec/>

To calculate the savings for each sample site, Nexant multiplied the measured roof area by the deemed savings rate of 0.35 watts per square foot.

Table 2-5 lists each site in the SB 5X sample population along with the reported roof area, verified roof area (measured by Nexant), and the verified savings.

**Table 2-5: Measurement and Verification Findings for SB 5X Sample Population**

Program Administrator	Project Name	Building Type	Reported Roof Area (sq ft)	Verified Roof Area (sq ft)	Verified Savings (kW)
LADWP	Encino Spa East	Multi-Family	75,000	84,390	30
	LAUSD-Buchanan Elem.	School	11,872	12,136	4
	LAUSD-Jordan High	School	29,149	35,849	13
	LAUSD-Nightingale Mid.	School	9,773	10,876	4
	LAUSD-Wonderland Elem.	School	10,877	11,253	4
	So. California Pipe Trades	Office	12,238	14,383	5
	Wilton Wilshire	Multi-Family	21,900	15,763	6
	Sherman Way	Office	18,000	13,558	5
	Gault Apartment	Multi-Family	7,100	5,791	2
	<b>Total LADWP</b>		<b>195,909</b>	<b>203,999</b>	<b>73</b>
SDREO	Art Gallery	School	1,520	1,500	1
	Barstow Community College-Gym	School	9,500	10,320	4
	Bradley Commerce Center	Industrial	5,998	4,148	1
	Brookhurst, Inc.	Industrial	33,892	23,877	8
	Building 11 & 12	Multi-Family	3,456	3,200	1
	Calypso Palms	Multi-Family	10,000	10,285	4
	City of Hope National Medical Center*	Other			
	Claremont New Life Vineyard	Other	9,255	9,067	3
	College of the Desert / Dining*	School			
	Country Club Corporate Plaza, Bldg. "I"*	Office			
	Emerald Center	Retail	72,875	71,253	25
	Maycock	Multi-Family	2,700	2,700	1
	Meyler Elementary LAUSD	School	5,619	5,834	2
	Montclair North Plaza Bldg "A" & "C"	Retail	5,000	14,676	5
	Orlimer Golf Equipment	Industrial	6,968	8,854	3
	Pilot/Broadleaf	Cold-Storage	48,519	47,649	17
	Preferred Freezer Services of Vernon	Cold-Storage	104,870	104,667	37
	Ramona Park	Multi-Family	18,000	15,671	5
	Regency Plaza Hotel	Other	16,427	15,306	5

Program Administrator	Project Name	Building Type	Reported Roof Area (sq ft)	Verified Roof Area (sq ft)	Verified Savings (kW)
	San Diego Tech Center	Office	177,664	142,737	50
	Science Drive	Industrial	98,627	98,000	34
	Sears, Roebuck & Company	Retail	101,032	97,451	34
	Southwestern College Building 220	School	8,500	8,107	3
	Sunrise Country Club H.O.A.*	Multi-Family			
	Target Store	Retail	58,509	44,309	16
	The Gas Company	Other	5,207	6,431	2
	Unocal Hartley Center	Industrial	14,800	18,331	6
	Villa Honda, Mazda, V. W.	Retail	22,249	21,600	8
	<b>Total SDREO</b>		<b>841,188</b>	<b>785,971</b>	<b>275</b>
SMUD	Blue Diamond Growers	Industrial	64,000	58,804	21
	Capital Power Federal Credit Union	Office	7,924	8,008	3
	Correctional Peace Officers Foundation*	Office			
	Crestwood Behavioral Health	Other	36,000	30,397	11
	CT Realty Co	Office	42,914	41,727	15
	Feickert (Elk Grove Unified School District)	School	18,276	14,070	5
	McClellan Park LLC Bldg. 652, City of Sacramento	Other	2,192	1,478	1
	McCreerys Home Furnishings	Retail	63,500	45,462	16
	Meadowview City Service Center Bldg "A"	Office	17,771	13,552	5
	Meadowview City Service Center Bldg "B"	Office	10,145	8,351	3
	Office Max/Joanns Fabrics	Retail	44,950	43,011	15
	Reza Gorgani	Multi-Family	12,210	13,722	5
	<b>Total SMUD</b>		<b>319,882</b>	<b>278,582</b>	<b>98</b>
STF	Ad Club	Office	3,724	3,532	1
	Chico Produce, Inc. DBA: Pro Pacific Fresh	Cold-Storage	68,400	66,120	23
	Commerce Center	Cold-Storage	117,701	131,029	46
	Del Mar Cold Storage	Cold-Storage	30,891	27,247	10
	Delta Brands	Cold-Storage	52,866	51,031	18
	Fitness Quest Health Club	Other	11,190	10,351	4
	GE Building, San Jose City College	School	14,496	14,374	5
	Guittard Chocolate	Industrial	281,891	256,483	90
	Historic Cary House Hotel	Other	5,956	5,257	2
	Lafayette Townhouse Apartments	Multi-Family	2,866	2,591	1

Program Administrator	Project Name	Building Type	Reported Roof Area (sq ft)	Verified Roof Area (sq ft)	Verified Savings (kW)
	Microwave Power, Inc.	Industrial	3,706	3,742	1
	Portage Road	Industrial	18,630	20,238	7
	Quad Wing, Benicia High School	School	10,542	7,373	3
	Rengstorff Ave.	Other	17,236	17,187	6
	Roseville Electric	Other	6,809	6,478	2
	San Leandro Plaza	Retail	47,944	45,905	16
	Sierra Beverage Company	Cold-Storage	37,824	25,537	9
	Sierra Vista Partners	Retail	20,881	11,118	4
	Target, West San Jose T-324	Retail	117,426	120,502	42
	Whiteford School	School	10,324	11,417	4
	Yosemite Meats Co., Inc.	Cold-Storage	7,313	5,092	2
	<b>Total STF</b>		<b>888,616</b>	<b>842,603</b>	<b>295</b>
	<b>Overall total</b>		<b>2,245,595</b>	<b>2,111,161</b>	741

\*Roof area for this project not measured due to difficulties encountered at the site. The absence of roof measurement does not affect the statistical validity of the overall findings.

## 2.5 PROGRAM ELEMENT EVALUATION

Nexant used the findings from our analysis of the sample projects to determine the verified savings for the program element as a whole. For each project administrator's sample projects, a realization rate was calculated. The realization rate was derived by dividing the sum of the areas measured by Nexant by the sum of the areas reported by the administrators. Table 2-6 shows the realization rates calculated for each program administrator for both AB 970 and SB 5X.

**Table 2-6: Realization Rates for the Program Administrators and Program Overall**

Program Administrators	Realization rate AB 970	Realization rate SB 5X
LADWP	0.94	1.04
SMUD	0.99	0.87
STF	0.92	0.95
SDREO	1.05	0.93
Overall for program	0.96	0.94

Nexant multiplied the realization rate for each administrator by the total area reported by that administrator (with the exception of LADWP for which numbers reported by the Energy Commission were used. Nexant was required to use the Energy Commission numbers because LADWP did not use the fields in the database required for this analysis.), yielding the administrator's total verified area. These verified areas were determined for each administrator and then summed together to determine the program-wide verified areas. These results were then



multiplied by the deemed savings factor of 0.35 watts per square foot, yielding the verified savings for each administrator and the program as a whole. The reported and verified numbers for projects invoiced to the AB 970 element are shown in Table 2-7 and those for SB 5X are shown in Table 2-8.

**Table 2-7: Application of AB 970 Realization Rates**

Program Administrator	Reported Roof Area (sq ft)	Realization Rate	Verified Roof Area (sq ft)	Verified Savings (MW)
LADWP	1,220,934	0.94	1,148,655	0.40
SMUD	1,771,137	0.99	1,753,426	0.61
STF	7,891,856	0.92	7,260,508	2.54
SDREO	4,281,736	1.05	4,495,823	1.57
<b>Total</b>	<b>15,165,663</b>		<b>14,661,532</b>	<b>5.13</b>

**Table 2-8: Application of SB 5X Realization Rates**

Program Administrator	Reported Roof Area (sq ft)	Realization Rate	Verified Roof Area (sq ft)	Verified Savings (MW)
LADWP	1,421,051	1.04	1,479,729	0.88
SMUD	2,420,127	0.87	2,107,665	0.74
STF	5,977,734	0.95	5,668,207	1.98
SDREO	7,908,283	0.93	7,389,175	2.59
<b>Total</b>	<b>17,727,195</b>		<b>16,644,777</b>	<b>5.83</b>

Several projects have been completed, but are not yet listed in the program administrator databases as being invoiced to either the SB 5X or AB 970 funding source. To estimate what the verified savings for those projects are, Nexant used realization rates that are averages of the SB 5X and AB 970 realization rates. Nexant also used these average realization rates to estimate the verified savings for projects that have been approved by the administrator but that are not yet completed. These estimated verified savings for completed projects that have not been invoiced and for approved projects that have not yet been completed are presented in Table 2-9 and Table 2-10, respectively.

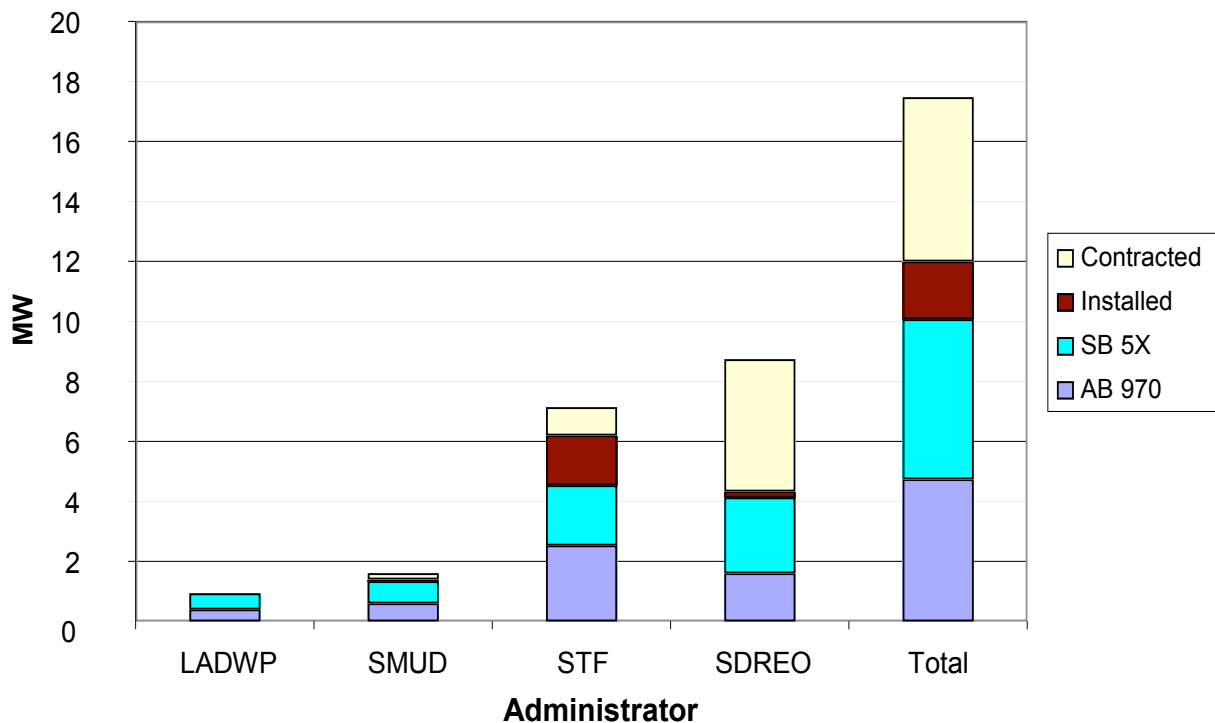
**Table 2-9: Application of Average Realization Rates (Installed, Not Invoiced Projects)**

Program Administrator	Reported Roof Area (sq ft)	Realization Rate	Estimated Verified Roof Area (sq ft)	Estimated Verified Savings (MW)
LADWP	0	0.99	0	0.00
SMUD	136,427	0.92	125,680	0.04
STF	5,211,733	0.93	4,858,184	1.70
SDREO	603,350	0.97	588,253	0.21
<b>Total</b>	<b>5,951,510</b>		<b>5,575,367</b>	<b>1.95</b>

**Table 2-10: Application of Average Realization Rates (Approved, Pending Projects)**

Program Administrator	Reported Roof Area (sq ft)	Realization Rate	Estimated Verified Roof Area (sq ft.)	Estimated Verified Savings (MW)
LADWP	0	0.99	0	0.00
SMUD	693,530	0.92	638,896	0.22
STF	2,782,424	0.93	2,593,672	0.91
SDREO	12,832,970	0.97	12,511,861	4.38
<b>Total</b>	<b>16,308,924</b>		<b>15,739,960</b>	<b>5.51</b>

Figure 2-2 illustrates the verified and estimated savings presented in Tables 2-7 through 2-10

**Figure 2-2: Verified and Estimated Savings by Program Administrator**

### 2.5.1 Error in Measurement and Verification Analyses

Nexant verified that we inspected a sufficient number of participating sites by calculating the coefficient of variance ( $C_v$ ) for each program administrator population and comparing the calculated  $C_v$  with the assumed  $C_v$  of 0.5. The 0.5  $C_v$  reflects an 80/20 confidence interval (80 percent certainty that the average demand savings calculated from sampled sub-populations are within 20 percent of the actual average for the entire population). Nexant's calculated  $C_v$ s were all below 0.5, indicating that our sample populations were of sufficient size.

The  $C_v$  is calculated using the following equation:

$$C_v = \frac{SD}{AVG}$$

Where:

- $C_v$  = Coefficient of variation
- SD = Standard deviation of project realization rates
- AVG = Average realization rate

The portion of the population sampled and the standard deviation of the sampled population affect the error for each subpopulation. Nexant calculated this sampling error using the following equation:

$$SE_{\text{samp}} = \sqrt{(1 - n / N) * SD^2 / n}$$

Where:

- $SE_{\text{samp}}$  = Sampling error
- n = Sample size
- N = Total population size
- SD = Standard deviation of the realization rates

The precision for each administrator was further affected by errors in verification measurements. Considering the accuracy of the measuring method (within 3 inches) and the number of measurements taken per site, Nexant has assumed a measurement error of five percent.

The  $C_v$ s for each of the program administrators are shown in Table 2-11. Also in Table 2-11 are the precisions calculated for each administrator at 80 percent confidence. The five percent measurement error has been included with the calculated sampling for each administrator using the root mean square methodology.

**Table 2-11: Coefficient of Variance and Precision Findings**

Program Administrator	C <sub>v</sub> for AB 970	C <sub>v</sub> for SB 5X	SB 5X Overall Error
LADWP	0.07	0.19	± 8%
SMUD	0.39	0.16	± 6%
STF	0.16	0.16	± 6%
SDREO	0.36	0.15	± 6%

Table 2-11 shows that the precision for all the administrators is well within the 20 percent target, even including the measurement error. In part due to the large sample size taken for STF and SDREO, Nexant is 80 percent confident that the calculated realization rate is within 6 percent of the actual for these two administrators.

The measurement error of five percent and the overall errors presented in Table 2-11 were used to determine the standard error for this element using the following equation:

$$SE_{Cool} = \sqrt{\sum (kW_{Vsamp} * ME)^2 + \sum (kW_{Vnonsamp} * OE)^2}$$

Where:

SE <sub>Cool</sub>	=	Standard error for the Cool Savings element
kW <sub>Vsamp</sub>	=	Verified savings from each project in the sampled population
kW <sub>Vnonsamp</sub>	=	Verified savings from non-sampled population for each administrator
ME	=	Measurement error
OE	=	Overall error

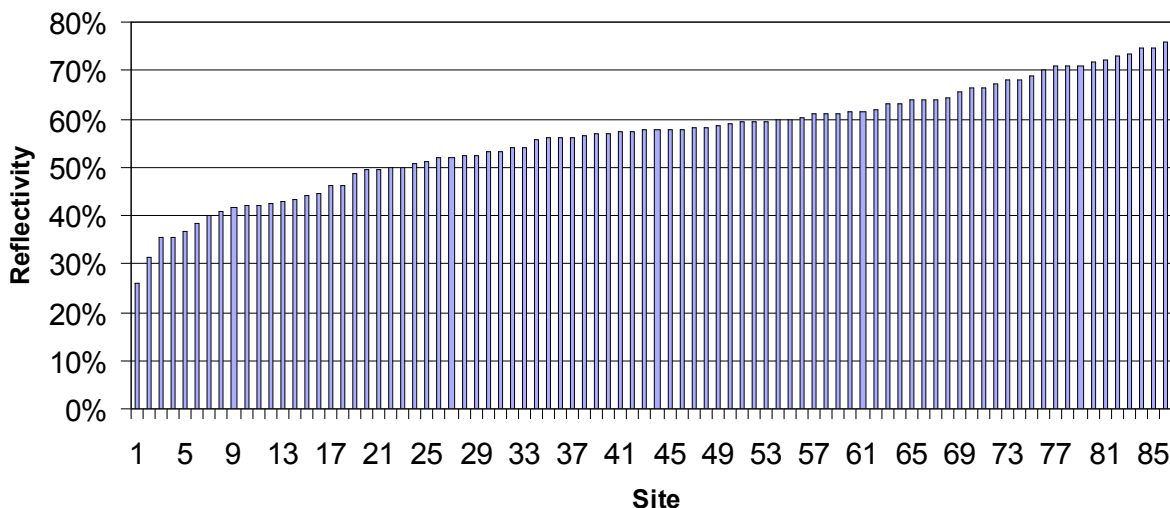
Also part of the error analysis is the addition of the intrinsic error to the deemed savings factor used to convert square feet to watts of peak savings. Nexant assumed an error of 15 percent for the deemed savings value. The deemed savings value is based on expert opinion and has an inherently large error when applied to a single site (potentially over 100 percent). When applied to an average of a population of several thousand the error is reduced to more on the order of 10 percent to 20 percent. This value was applied to the verified savings for the entire population of Cool Savings projects. It should be noted that most of this error is due to the uncertainty of the deemed savings factor. The measurement and sampling errors alone would have a standard error of only 0.7MW.

The results of these calculations were multiplied by 1.28, the z-statistic for an 80 percent confidence, to yield a total standard error for the combined AB 970/SB 5X Cool Roof program plus or minus 3.6 MW or slightly better than 20 percent error at 80 percent confidence.

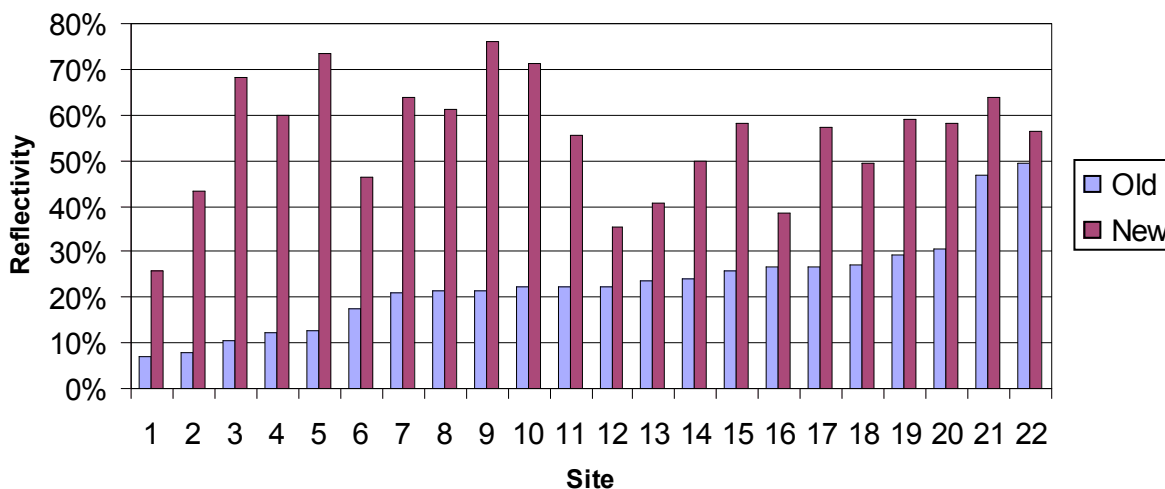
### 2.5.2 Reflectivity Analysis

Between the AB 970 and SB 5X elements, Nexant took reflectivity measurements on installed cool roofs at 87 sites. The reflectivity at these sites ranged from 25 to 76 percent, and averaged 56 percent. This average reflectivity measurement of aged roofs (see below) is 20 percent less than the 76 percent average for the laboratory measured reflectivity for the materials used at these sites. The average reflectivity measurement is also nine percent less than the 65 percent reflectivity requirement of the program. Twenty-three of the sites had a reflectivity of less than 50 percent. As discussed in detail later in this section, Nexant attributes the low reflectivities to the ages of the measured roofs; the decrease in reflectivity is accounted for in the deemed savings rate of 0.35 watts per square foot. Figure 2-3 shows the post-installation reflectivity for each of the 87 sites.

**Figure 2-3: Post-Installation Percent Reflectivity**

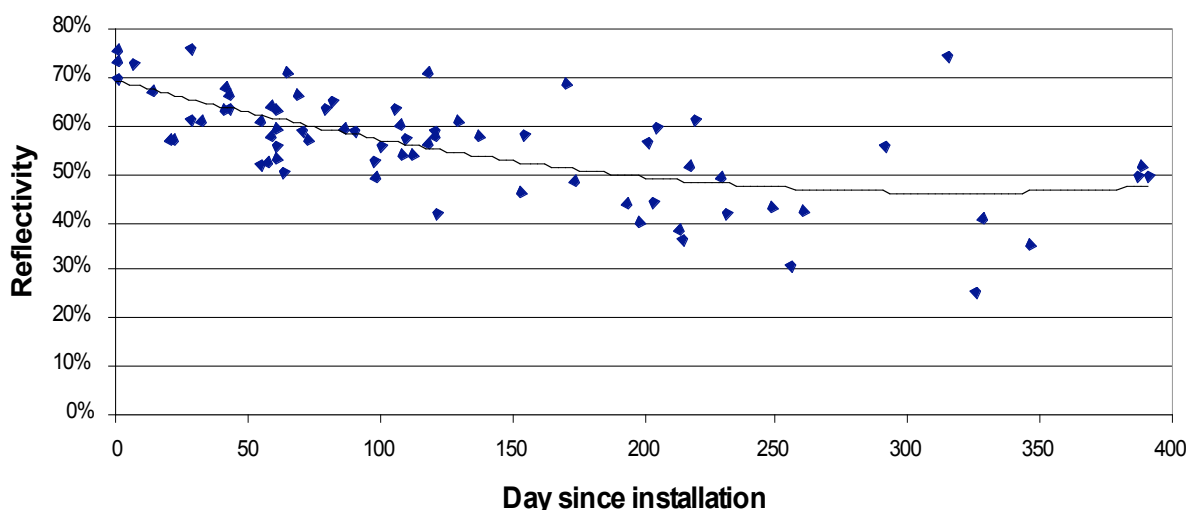


Of the 87 sites where post installation reflectivity measurements were taken, 22 had pre-installation data available. The pre-installation roof reflectivities ranged from 7 to 49 percent and averaged 25 percent. The reflectivity increase for these 22 sites ranged from 7 to 61 percent and averaged 32 percent. Figure 2-4 shows the old and new reflectivity for each of the 22 sites.

**Figure 2-4: Percent Reflectivity for Old and New Roof Surfaces**

Nexant noted a significant difference in verified reflectivity between AB 970 and SB 5X sites. The average reflectivity for the 40 sites measured in 2001 under AB 970 was 61 percent, while the average reflectivity for the 47 SB 5X sites was 53 percent. Similarly, for those projects with both pre-and post-installation data, the increase in reflectivity for AB 970 projects averaged 42 percent while for SB 5X projects the average increase in reflectivity was only 25 percent.

An analysis of the relationship between the measured reflectivity and the age of the new roof showed a trend of reduced reflectivity over time. On average, the longer the roof had been installed, the lower the reflectivity. Figure 2-5 shows the reflectivity measured during the Nexant evaluation of the site plotted against the number of days after installation the measurements were taken. Each point on the plot represents one of the 73 sites for which the installation date and reflectivity were available (the date of installation was not available at 14 sites). The average time between installation and measurement is 142 days for these sites. The trend line in Figure 2-5 shows a steady decline in reflectivity over time with a drop from the high 60s to the high 40s over the first 200 days. The trend line also shows that decline slows and levels out after 10-12 months with average reflectivity holding steady in the high 40s from 200 to 400 days after installation.

**Figure 2-5: Reflectivity Over Time**

The weather and time of day were not significant factors in these results. The albedometer used measured light from a hemisphere and thus was not affected by the angle of the sun or diffuseness of the light. Furthermore the most of the readings were taken between 10am and 4pm on sunny days further reducing the impact of these factors.

This observed reduction in reflectivity had been accounted for in the deemed savings rate of 0.35 watts per square foot. The final average reflectivity presented, around 50 percent, is consistent with that expected by researchers at Lawrence Berkeley National Laboratory who derived the deemed savings rate.

### 2.5.3 Building Type Analysis

Nexant analyzed collected data in terms of building type to determine the existence of any notable trends. The findings of this analysis, specifically the realization rates, were not used in the verification of savings for the Cool Savings program element. Realization rates and savings values in this section are intended for demonstrating the differences among building types and cannot be compared to values in other sections. This analysis reflects all projects listed in administrator databases, including those still pending approval. Thus, the totals here will be different from other sections.

As discussed earlier, Nexant sampled a sufficient number of SB 5X projects to evaluate projects by their building type. Listed in Table 2-12 are the seven building types evaluated, the total estimated number of enrolled participants in each, and their resulting realization rates (determined using the same methodology as for the administrator subpopulations). The total number of enrolled participants is slightly larger than the contracted number because it includes 40 sites that have not yet been approved.

**Table 2-12: SB 5X and AB 970 Projects by Building Type**

Building type	Total Enrolled Participants	Realization Rate	Reported Area Enrolled (sq ft.)
Cold storage	63	0.98	3,359,968
Multifamily	195	0.93	7,694,092
Industrial	289	1.01	6,318,882
Office	595	0.85	13,963,747
Other	302	0.92	5,885,102
Retail	366	0.93	13,149,517
Schools	510	1.02	8,381,012
<b>Total</b>	<b>2298</b>		<b>58,752,320</b>

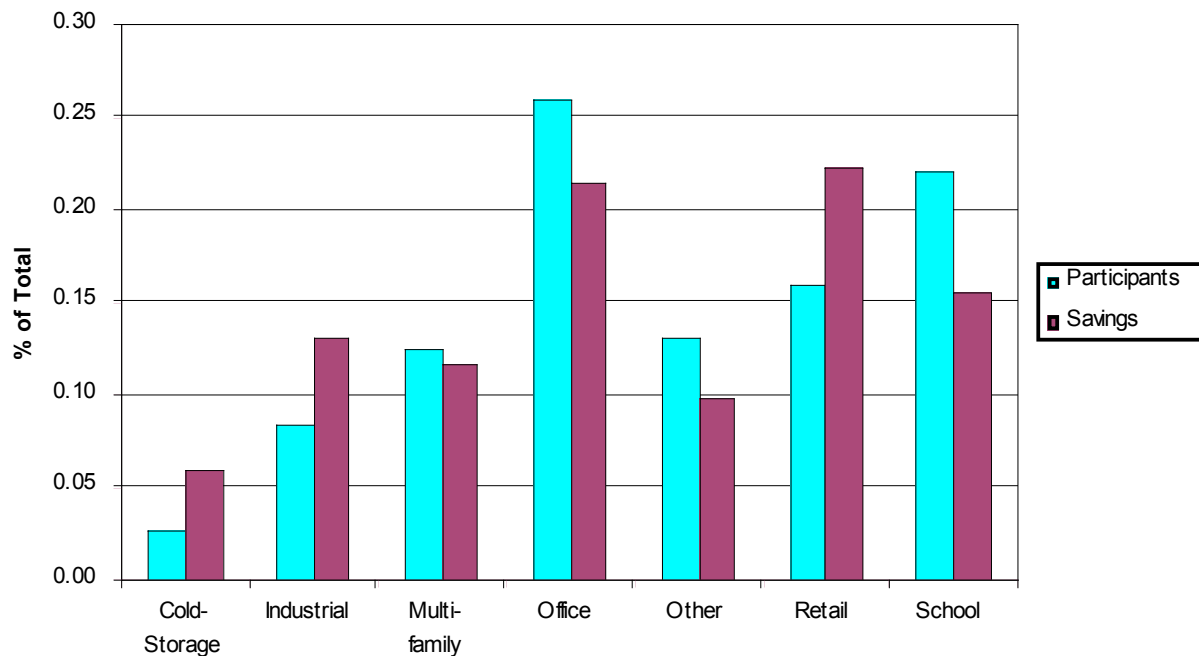
The realization rates and reported areas for each building type were multiplied together to get the verified area for each building type. The resulting verified areas were then multiplied by the deemed savings factor of 0.35 watts per square foot, yielding verified savings. The resulting numbers are shown in Table 2-13.

**Table 2-13: Measurement and Verification Findings by Building Type**

Building Type	Reported Area (1000 sq ft)	Realization Rate	Verified Area (sq ft)	Verified Savings (MW)
Cold storage	3,359,968	0.98	3,292,769	1.15
Multifamily	7,694,092	0.93	7,155,506	2.51
Industrial	6,318,882	1.01	6,382,071	2.22
Office	13,963,747	0.85	11,869,185	4.14
Other	5,885,102	0.92	5,414,294	1.90
Retail	13,149,517	0.93	12,229,051	4.28
Schools	8,381,012	1.02	8,548,632	2.99
<b>Overall</b>	<b>58,752,320</b>	<b>0.98</b>	<b>54,891,508</b>	<b>19.19</b>

Figure 2-6 compares the contribution of each building type as a percentage of total enrolled participants and total area. This figure shows that schools and offices had the greatest participation, each with about one quarter of the total number of participants. Cold storage and industrial sites had the fewest participants. Offices and schools each have a smaller portion of the savings than of the number of participants. Cold storage, industrial, and retail each have a larger portion of the savings than of participants. This discrepancy in savings verses participation is due to the average size of roof areas for each building type; cold storage, industrial, and retail have larger roof areas on average than offices or schools. The size translates directly through the deemed savings value to the savings for each building type. The average savings per participant by building type is shown in Table 2-14.



**Figure 2-6: Comparison of Percentage of Participants and Savings by Building Type****Table 2-14: Average Savings per Project by Building Type**

Building type	Average savings (kW/site)
Cold storage	18
Multifamily	13
Retail	12
Industrial	8
Office	7
Other	6
Schools	6
<b>Overall average</b>	<b>8.3</b>

These findings can be used in the design and implementation of future programs. Programs can focus more on the sites with a larger average savings—cold storage, multi family, and retail—to get the most savings from the fewest sites and save on administration fees. Or they can target a high number of participants by focusing on offices, schools, and retail sites. Retail sites, with a high average savings per site and participation, should be included in any program.

### 2.5.4 Air Conditioner Stock Analysis

The MV&E plan called for using data gathered on HVAC systems to determine a population average coefficient of performance. Unfortunately, Nexant was unable to identify a source of either initial coefficient of performance values or degradation factors for the older units, which make up most of the population. The information was thus not usable in our analysis and is presented here to show what was learned about the HVAC population.

Nexant gathered data on air conditioner characteristics at 57 of the 70 sites evaluated under the SB 5X program. Of those analyzed, 42 had package units and 17 had chillers (2 had both package units and chillers). Data was gathered on the age and size of the units. In some cases, only the age or only the size was discernable or available. The 46 sites with age data have an average age of 13.4 years and an age distribution as shown in Figure 2-7. Three of the sites had units of widely different ages and are not included in Figure 2-7.

**Figure 2-7: Age of AC Units by Site**

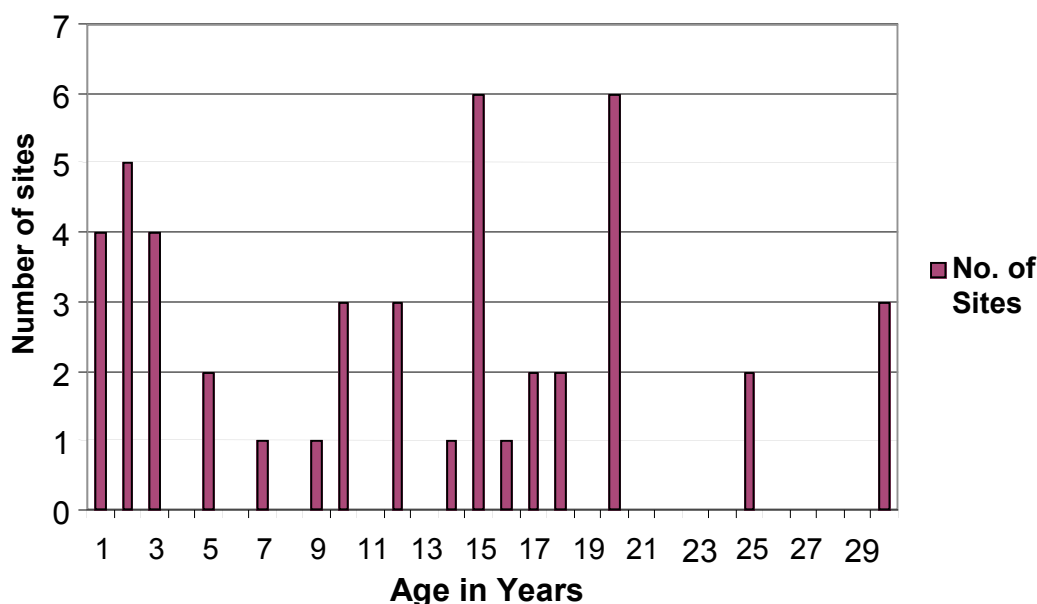
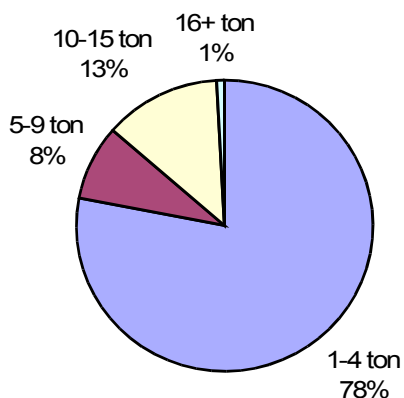


Figure 2-8 breaks the population of package unit down by size. This figure shows that, of the 585 units on which Nexant was able to gather size data, 78 percent were less than 5 tons.

**Figure 2-8: Size Distribution of AC units**

## 2.6 COST-EFFECTIVENESS

Program cost effectiveness is calculated as levelized cost per unit of demand reduction and expressed as \$/kW-yr. The general equation for calculating levelized costs of demand reductions is taken from the Energy Commission's *Standard Practice Manual: Economic Analysis of Demand-Side Management Programs*, (1987). The formula for levelized cost at the project level is as follows:

$$LC = C/DR$$

Where:

- LC = Levelized cost
- C = Total Energy Commission costs
- DR = Total discounted demand reductions of the project

Since almost all funding has occurred up front, no discounting of the cash flow is required. Demand reductions are expected to persist for 10 years. Thus, each project requires discounting the annual expected demand reductions as follows:

$$kW_{total} = \sum_{n=1}^t \frac{kW}{(1+d)^{(t-1)}} = kW \left[ 1 + \frac{(1+d)^{(t-1)} - 1}{d(1+d)^{(t-1)}} \right]$$

Where:

- $kW_{total}$  = Project discounted kW years (DR)
- kW = Expected demand reduction each year
- d = Discount rate, 4.1 percent
- t = Project lifetime in years (10 years for Cool Roofs)

This equation does not discount demand reductions in the first year. Using this methodology, and assuming a product life of 10 years, Nexant estimated the levelized cost of the \$0.15/sq.ft

incentive (about \$430/kW) to be \$51/kW-year. This \$51 is the minimum expected since it reflects only incentives paid and not the costs of administering the program. It is used as a benchmark to evaluate the results from the analysis of reported costs.

Nexant analyzed the accounting numbers provided by the Energy Commission. The accounting numbers reflect the Energy Commission's costs associated with designing and administering the program reported by the middle of January 2003 so they savings are slightly larger than those reported by the administrators in mid December. Tables 2-15 and 2-16 show the levelized cost for the verified savings for AB 970 and SB 5X based on the data provided by the Energy Commission.

**Table 2-15 AB 970 Cost Effectiveness Based on Energy Commission Data\***

Project Administrator	Amount Invoiced	Verified Savings**	Simple Cost	Levelized Cost
LADWP	\$248,119	405 kW	\$613/kW	\$73/kW-yr
SMUD	\$463,550	653 kW	\$668/kW	\$80/kW-yr
STF	\$1,831,826	2561 kW	\$715/kW	\$85/kW-yr
SDREO	\$1,005,597	1709 kW	\$588/kW	\$70/kW-yr
<b>Overall</b>	<b>\$3,557,854</b>	<b>5378 kW</b>	<b>\$665/kW</b>	<b>\$79/kW-yr</b>

\*Reflects both incentive payment costs and program administration costs.

\*\* The realization rates calculated for the administrators were applied to the savings in the Energy Commission report to yield a verified savings.

**Table 2-16 SB 5X Cost Effectiveness Based on Energy Commission Data\***

Project Administrator	Amount Invoiced	Verified Savings	Simple Cost	Levelized Cost
LADWP	\$111,858	520 kW	\$512/kW	\$26/kW-yr
SMUD	\$328,630	713 kW	\$461/kW	\$55/kW-yr
LGC	\$3,118,649	5,170 kW	\$603/kW	\$72/kW-yr
<b>Overall</b>	<b>\$4,032,285</b>	<b>6,403 kW</b>	<b>\$629/kW</b>	<b>\$75/kW-yr</b>

\*Reflects both incentive payment costs and program administration costs.

The AB 970 levelized cost in Table 2-15 for the program administrators are reasonably close to the average, and since the program is near completion with relatively few new projects, these are likely the final values. The SB 5X overall levelized cost in Table 2-16 is higher than any of the administrator rates because it includes several additional charges associated with the program, but performed by other entities. These other charges did not result in any significant energy savings. The low LADWP number is likely due to delays in reporting.

Nexant estimates the overall program level cost effectiveness for the Cool Roofs/Cool Savings program element to be \$78/kW-yr. This estimate is based on the near-complete status of AB 970 reporting and the expectation that the SB 5X value will increase as more invoices are reported.

## 2.7 PERSISTENCE VERIFICATION

The purpose of persistence verification is to determine whether the verified savings for projects installed in 2001 persisted until the end of 2002. Nexant conducted persistence verification in November of 2002 for 42 of the 51 projects that were in the AB 970 sample population to determine whether the savings had indeed persisted. The remaining nine projects had either dropped out of the program or their implementers were unable to be reached. The demand impacts of withdrawn projects are accounted for in reduced square footage, and do not affect savings persistence.

Nexant's methodology for persistence verification involved site visits (for 10 projects) and telephone surveys (for 32 projects). During the site visits, Nexant measured the solar reflectivity of the roofs and compared these readings to those taken previously in 2001 to see if there was any solar reflectivity deterioration and, if so, how much.

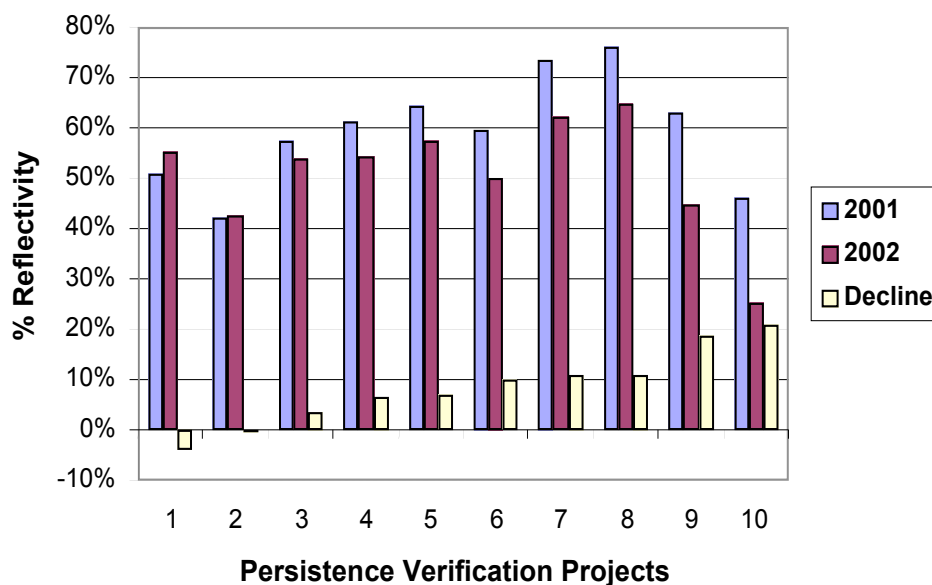
During the telephone surveys, Nexant asked participants the following questions:

1. Is the space on the floor below the roof still in use?
2. Is the space still air-conditioned?
3. Has the roof been repaired or added to since the original cool roof was installed?
4. Does the roof still appear to have reflective qualities remaining?
5. Were there any problems with the roof performance?

Nexant used the answers to Questions 1 and 2 to determine whether or not any significant operational changes occurred at the site. If Nexant determined that the space below the roof was no longer being conditioned, we assumed the savings for that site had not persisted at the level verified in 2001. Nexant used the answers to Questions 3 through 5 to determine whether or not there were any changes in the physical properties to the roof. If significant changes had occurred, Nexant assumed that the savings at the site had not persisted at the same level as verified in 2001. Examples of significant changes include the roof having been pulled up or covered over, the roof having undergone extensive repairs, the addition of new roof-mounted equipment, or the roof having otherwise been deemed unreflective by the respondent.

### 2.7.1 Summary of Results

During the 10 site visits, Nexant obtained solar reflectivity measurements. The measurements showed that the average solar reflectivity readings for the visited sites dropped from 59 percent in 2001 to 51 percent in 2002. Figure 2-9 shows the percent change in roof reflectivity for each of the 10 sites.

**Figure 2-9: Percent Reflectivity Change per Project**

The cause of this decrease in reflectivity is likely the accumulation of dirt on the roofs. The large increase seen at site 1 may be due to the roof being cleaner during the second visit than it was during the first in 2001 (the 2001 site inspector noted significant dirt on the roof). It might also be possible that the 2002 measurements were taken on a different roof, as there were several participating buildings at the site. The slight increase in reflectivity at site 2 is within the measurement error of the albedometer, used for measuring roof reflectivity. During each site visit, Nexant also verified that no significant operational changes or changes to the physical properties of the roof had occurred that would have affected the persistence of savings from 2001 to 2002.

In the telephone surveys, all but one of the 32 participants reported that they are still using the space in the floor just below the roof as they had previously and are still air-conditioning these spaces. One participant, the Saratoga Office Center, told Nexant that only 25 percent of the originally included space was still used and air-conditioned. The 75 percent drop in affected space at the Saratoga Office Center accounts for a 2 percent drop in the total square footage of the AB 970 sample population. Based on this change, Nexant reduced the realization rate for the AB 970 program by 2 percent and adjusted the verified savings accordingly.

Five participants reported that roof repairs had been required in the last year. However, Nexant determined that none of the repair work was significant enough to have affected savings persistence. Thirty respondents reported that the roof still appeared to be reflective; two said they didn't know.

Twenty-nine said that the roof performance was generally satisfactory, with three reporting the occurrence of small leaks. Based on participant's description of the leaks, Nexant determined that the leaks did not have an affect on savings persistence.

### **2.7.2 Participant Feedback**

In addition to the survey questions and site visits, Nexant also solicited and recorded general feedback about the program.

Most respondents had positive comments. These respondents said they appreciated the rebate and the energy savings and that the program and the product work well. One said that he believes it enhances the building's value. A couple others noted that occupants could tell the space was not as hot. One participant was happy that it reinforced the roof. Regarding the program itself, one respondent stated that, when compared to Energy Commission's program, other rebate programs weren't worth the time. A number of participants used the term "smooth" to describe the process. Some said they would readily participate if the program were to be extended.

Nexant received a handful of negative comments about the program and the energy savings, but none about the products themselves. A few participants felt that savings from the program were hard to confirm. Comments included the fact that they couldn't quantify savings on bills or they saw energy savings but had a hard time showing cost savings because overall energy bills rose due to prices rising. One participant felt the program was too bureaucratic. A few participants had issues with contractors. The most negative experience seemed to be from the San Juan Car Wash project representative; the respondent said that he had not received his rebate when we spoke in November and that his contractor went out of business. His impression was "not good."

### **2.7.3 Persistence Verification Conclusions**

Nexant's persistence verification findings indicate that 98 percent of the savings we verified in 2001 have persisted through to the end of 2002. The two percent drop is attributed to the 75 percent reduction in covered square footage at the Saratoga Office Center. This reduction also translates into a two percent reduction in the overall realization rate for the AB 970 program, from 98 to 96 percent.

The comparison of reflectivity readings shows that, on average, reflectivities dropped an average of eight percent from 59 to 51 percent in the program year 2001-2002. This drop is consistent with what was expected under the program, and is not an indication that verified savings have not persisted.

Dirt accumulation on roofs is suspected to be a major factor in reduction of reflectivity over time. The rainy season in the winter acts as a natural cleaning cycle, but during the peak season, there is typically little rain to perform that function. The reduction in reflectivity is not expected to compound over the years, as the winter rains should remove most of the annual dirt accumulation. In order to verify this assumption Nexant, recommends that a few of the sites whose reflectivity was tested for persistence be re-tested again in 2003 along with up to 10 additional sites that have been in place over one year.

## 2.8 ADMINISTRATORS AUDIT AND PARTICIPANTS AUDITS

### 2.8.1 Administrator Audits

The purpose of the program administrator audit was to determine the effectiveness of third-party program administration for the Energy Commission's Peak Load Reduction Programs. In the Cool Roof program element, there are five administrators, four of which were audited. LGC was not audited because STF and SDREO dealt with and maintained the records for LGC participants.

The audits took place between December 2002 and the end of January 2003 and were performed by Nexant staff members in person at the designated administrator's office. Administrators were required to allow a review of a random sample of their program files to verify that a paper tracking-system was in place.

Thirteen questions were asked of administrators. The first seven questions covered each area of the administrator's responsibilities throughout the program process. The last six questions were about the administrator's record-keeping practices to discern their level of organization and to check that the procedures and responsibilities, where required by the Energy Commission, had been followed. For Questions 1, 2, and, 7, respondents could give more than one answer.

### 2.8.2 Methodology for Audits

A checklist form was developed for use in the administrator audits. This checklist was based on the administrator requirements as laid out in their Energy Commission contracts, and on key performance indicators such as participant recruitment, customer service, M&V, and delivery of demand savings. Each of the four administrators was evaluated based upon the criteria outlined in this checklist below. Information to complete the checklist was gathered through administrator interviews and audits of administrators' records.

### 2.8.3 Administrator Audit Checklist

The administrative audit encompassed six categories, each with its own focus. These categories were:

1. *Participant Recruitment*—determined what methods and materials administrators used to market the program and how successful they were. Criteria considered included use of sales force, communication with vendors, use of flyers and websites, and number of participants and dropouts.
2. *Customer Service*—determined what offerings administrators made to participants to assist them in project implementation. Criteria considered included incentives, equipment, services, and training.
3. *Project Eligibility*—determined whether projects were eligible as defined by the administrator's program guidelines. Criteria considered included demand reduction or supply augmentation, prior project operability, duration of project, measurability of savings, and size of the participants' facilities.



4. *Verification Requirements*—determined the breadth and depth of the administrators’ verification process. Criteria included cooperation with third-party verification contractor M&V efforts, method of verification (site visit, data monitoring), and verification sampling plans.
5. *Reporting*—determined the administrators’ compliance with program reporting requirements, including participation and savings updates and general communication with contract manager.
6. *Documentation*—determined whether the administrator kept proper records for participating projects. Criteria considered includes: hardcopy and electronic filing systems, invoices, and incentive payment tracking.

#### 2.8.4 Summary of Responses

Following is a discussion of the responses to the 13 questions used as part of the administrative audits. The first six questions are qualitative in nature; the latter seven are quantitative, and ask for a rating of between one and five, with five being the best rating a respondent could give.

**Question 1:** How were participants recruited?

All of the four administrators held seminars for vendors and customers to inform them about the program. SDREO held publicly announced workshops in five counties; STF held three seminars; SMUD focused on workshops for vendors to help them learn program requirements and paperwork. Of the four administrators, three also ran direct mail campaigns for prospective participants. SMUD sent direct mail to property owners and its small commercial and industrial accounts. STF and SDREO went through industry associations to reach vendors and customers.

**Question 2:** What marketing material was used to attract participants?

All administrators used a flyer or brochure to market the program. In addition SDREO developed case studies and SMUD used their website.

**Question 3:** (a) How many participants are participating as of December 31, 2002, and  
(b) How many participants dropped out since the program’s inception?

As Table 2-17 shows, all of the administrators reported some loss of participants in the year and a half since the program’s inception.

**Table 2-17: Reported Number of Participants and Dropouts**

Administrators	Participants	Number Dropped Out	Percent Dropped Out
LADWP	214	<20	<10%
SDREO	903	101	9%
SMUD	201	15	7%
STF	939	136	15%

**Question 4:** Were participants offered training or any other instructional help during any time of their participation?

SMUD trained their contractors on program requirements, since their program relied on these contractors for marketing and evaluation efforts. Other administrators made themselves available to answer participants' questions as they came along. LADWP estimated that about 5percent of participants had questions beyond those associated with application processing.

**Question 5:** How did you evaluate your projects?

All administrators used application forms to determine initial program eligibility. SDREO and STF noted that they initially performed site inspections but had stopped this practice due to the expense. All administrators reviewed applications for reasonableness. LADWP did telephone reviews, while SMUD had the approved roofing contractors evaluate projects.

**Question 6:** a) How did you verify installations?  
b) How many participants or sites were verified, and  
c) Was a sampling plan used for this?

As shown in Table 2-18, the administrators used site visits to verify installations to varying degrees: two performed visits for all projects while the other two only visited questionable projects.

**Table 2-18: Administrator Verification Methods**

Administrator	How Verify	How Many	Sampling Plan?
LADWP	Pre-and post-field inspections	All	Verify all
SDREO	Paperwork, site inspection if questionable	N/a	None
SMUD	Visit	All	Verify all
STF	Initial site visits to all, then to questionable ones, then by phone	N/a	None

**Question 7:** What method was used to track and report project progress to the Energy Commission and/or the M&V contractor?

All administrators utilized the database designed by the Energy Commission to different extents. All administrators also maintained separate spreadsheets to track the progress of each participant through their process. The Energy Commission database did not seem to meet their needs, so they captured data in their own ways and uploaded whatever was necessary to the Energy Commission database for reporting.

Questions 8-13 are about record keeping, and are answered with ratings based on a 5-point scale, with five being highest. For each the four administrators, Nexant randomly selected 10 participants and reviewed the project files (40 projects total). Nexant gave each administrator a rating of 5 for each of the questions in Table 2-19.

**Table 2-19: Questions 8-13**

Question Number	Question
8	Are documents available for the sampled projects in question?
9	Were invoices valid with proper documentation and consistent with the initial between parties involved and the program requirements?
10	Was the verification process noted above followed?
11	Did the installed equipment agree with the invoice?
12	Were participants paid according to the customer agreement?
13	Was the tracking/reporting method noted above maintained?

### 2.8.5 Administrator Audit Conclusions

Marketing and recruitment were primarily done through workshops and direct mailings. Administrators observed that marketing the program to product vendors, roofing contractor, and rather than directly to building owners was a more efficient means of advertising the program. Each vendor, contractor, and roofing contractor served as a distributor for program information to the respective client base.

Initially, administrators tried to do pre-and/or post-inspection on most of the participants however this method of site verification proved to be cost prohibitive exceeding the 10 percent administration fee imposed by the Energy Commission. Therefore site visits and inspections stopped all together or were used only with participants with more unusual or complicated applications.

Nexant's audit discovered that all the administrators kept good paper files while also maintaining their own project-tracking databases. The level and quality of data entered into the Energy Commission database varied. While all administrators used this database to some extent it was found to be less familiar than the one each administrator developed for to track the day-to-day progress of projects.

## 2.9 PARTICIPANT AUDITS

Nexant conducted participant audits for the Cool Savings program. The purpose of the audits was to evaluate participants' compliance with the programs' various rules and requirements. These interviews also provided an indication of the level of satisfaction with the administrator's program process design. All participant audits for the Cool Savings program were conducted over the telephone.

### 2.9.1 Methodology for Audits

Participants audited were selected from the approved MV&E sample for SB 5X. Nexant's audit plan called for sampling sufficient participants from each administrator to reach the required 80/20 confidence. Using the same methodology for determining sample sizes in our demand impact evaluation, Nexant determined the required number of audits for each administrator based on the number of participants. Nexant continued attempting to recruit participants for the audit activities until the sample size population had been met. Table 2-20 below shows the breakdown of audited participants by program administrator..

**Table 2-20: Audited Projects by Program Administrator**

Program administrators	Participants in SB 5X sample population	Participants in audit population
LADWP	6	4
SMUD	11	4*
STF	21	7
SDREO	28	7
<b>Total</b>	<b>66**</b>	<b>22</b>

\*Nexant attempted to audit six of SMUD's participants, but some participants were unable to be reached and others refused to be audited.

\*\*Note that some of the participants had multiple projects in the sample so there are fewer participants listed here than projects in Table 2-3

### 2.9.2 Participant Audit Checklist

Nexant developed 16-question telephone survey for participants. The first seven questions ask participants about aspects of the program's process. Questions 8-10 ask about how this process went and if participants would again participate in a like program in the future. Questions 11-16 ask participants to rate their level of satisfaction with each aspect of the program on a scale of one to five, with a five indicating the highest level of satisfaction. It should be noted that not every respondent answered every question, so question totals may not always add up to 22 responses. Additionally, several of the questions received multiple answers.

**Question 1:** How did you find out about the Energy Commission Cool Savings Program?

Twenty-one respondents answered. Nearly half of respondents listed their roofer or contractor as their source of knowledge about the program. Other answers were: learned about the program through a utility, from an employee, from a neighbor, or through other unnamed sources.

**Table 2-21: Source of Program Information**

Source	No. of Responses
Roofer/Contractor	10
Utility	4
Consultant	1
Energy Commission	2
Advertisement	2
Other	2
<b>Total</b>	<b>21</b>

**Question 2:** Why did you participate in the program?

For this question, participants gave more than one answer. The financial incentives were clearly the greatest motivator among respondents. Numeric results are shown in Table 2-22.

**Table 2-22: Question 2 Reasons to Participation**

Source	No. of Responses
Rebate	18
Save energy	6
Fix roof	3
Building climate	2
<b>Total</b>	<b>29</b>

**Question 3:** Did you participate in any other similar roofing or peak load reduction programs?

Of the 22 responses, 13 answered no and nine yes. The additional detail Nexant received confirmed that "yes" respondents also participated in various statewide utility programs.

**Question 4:** Rate the overall quality of the communication process with your administrator

Nexant received answers from 20 respondents. Some of the difficulties that were mentioned included difficulty in defining the nature of the program and disagreeing with the administrator's calculations for qualifying spaces and square footage. The average rating was 4.1.

**Question 5:** By what means did you most often communicate to your administrator?

All of the 22 respondents answered this question. The answers were as would be expected. Communication about the program was carried out by telephone, surface mail, email, and fax. Many of the respondents used more than one form of communication.

**Question 6:** How long did it take for you to be notified about your application status after you submitted it?

Of those responding, the answers varied from not remembering to several weeks as shown in Table 2-23.

**Table 2-23: Question 6 Response Time**

Source	No. of Responses
Days	2
Weeks	11
Months	3
Called the Energy Commission	3
Could not remember	3
<b>Total</b>	<b>22</b>

**Question 7:** Did your program administrator visit your project to verify project completion?

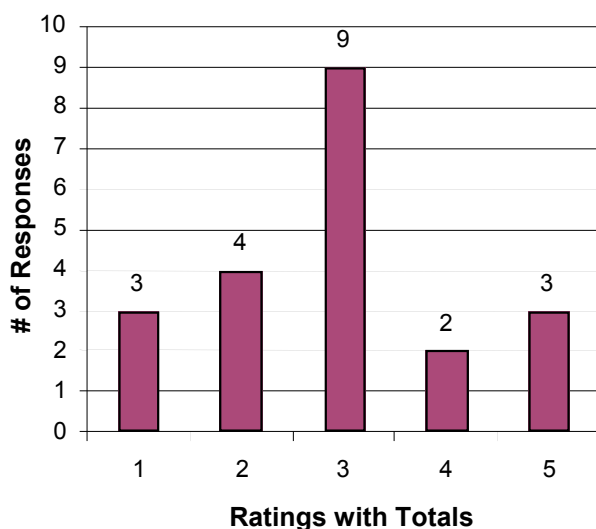
All participants answered yes.

**Question 8:** Rate the obstacles you encountered as if you were to implement the project again on a scale of 1 to 5, where a 5 indicates that no significant obstacles encountered; 3 indicates that significant obstacles were encountered, but you would conduct the project again; and 1 indicates that significant and prohibitive obstacles were encountered.

Twenty-one respondents answered. One respondent rated this question a 1, saying they ran into a lot of obstacles to project completion. No additional explanation was given. The average response was 4.2.

**Question 9:** On a scale of 1 to 5, rate the likelihood that you would have performed peak load-reducing actions without this program, where a rating of 5 represents yes, without question; 3 represents yes, but under different circumstances; and 1 represents no, not under any circumstances.

Twenty-one respondents answered. The average was 2.9 with the distribution shown in Figure 2-10.

**Figure 2-10: Question 9, Likelihood of Acting without the Program**

**Question 10:** On a scale of 1 to 5, based on your experience with this program, would you participate again in a similar program? A rating of 5 is yes, without question; 3 is yes, but under different circumstances; and 1 is no, not under any circumstances. None of the 22 respondents rated this question below three. The average was 4.8.

Questions 11-16 used a 5-point scale to rate participant satisfaction with various aspects of the program, with five being the highest level of satisfaction. The questions are:

How would you rate your experience with the following?

11. The Cool Savings program as a whole?
12. Your administrator?
13. The application process?
14. The invoicing, billing, and payments process?
15. The verification process?
16. The implementation timeline you were on?

Every participant replied to every question, except for Question 14, which one respondent skipped.

The overall program got the highest average rating, followed closely by the verification process. The payment process was the only category to receive an average below four. Table 2-24 below shows the count of each rating for Questions 11-16.

**Table 2-24: Program Component Ratings Count**

Question Number	Question	Ranking Scale					Average
		1	2	3	4	5	
11	Overall program	0	0	3	8	11	4.4
12	Administrator	0	0	6	5	11	4.2
13	Application process	0	2	2	10	8	4.1
14	Payment process	2	1	4	7	7	3.8
15	Verification process	0	0	4	7	11	4.3
16	Timeline	2	0	2	7	11	4.1

### 2.9.3 Participant Audits Conclusions

Most of the respondents heard about the program from roofers and contractors who did self-promoting because they installed cool roofs. Incentives, as would be expected, did also drive participation. Respondents seemed generally happy with the communication process. Most participants received responses to their applications within a matter of weeks, which was acceptable to them. Participants did not encounter any major obstacles to project installation overall.

Although almost all of the participants were interested in being part of another similar program, they were unsure whether they would have implemented their project without the support of the Cool Roof and Cool Savings programs.

## 2.10 CONCLUSIONS

The Cool Roof and Cool Savings program elements can be considered a success. As of mid-December 2002, the AB 970 and SB 5X program elements combined had enrolled over 2,250 customers and achieved 11.8 MW of verified savings through the installation of over 35 million square feet of cool roof material, all at a cost of only around \$80/kW/year.

During the course of the program, both STF and SDREO were able to enroll almost 1,000 participants each, indicating that small public or private organizations can have the resources and motivation to make a program attractive and successful.

The program administrators have invested considerable time in public outreach and education to increase awareness among building owners, roofing companies and contractors, property management firms, and facility managers about the benefits and savings associated with cool roofing materials. Changes in consumer and producer viewpoint will, however, take more time and continued effort.

Contributing factors to the slow penetration of the cool roof products include the time needed by participants to become educated on this new technology, and the difficulty of changing peoples' perceptions of what color their roofs should be.



As a potential cost saving measure, Nexant recommends investigating the use of contractors to promote the program and the use of cool roofing materials. Most roofing projects are specified in consultation with contractors and nearly 50percent of the participants surveyed learned of the program from their roofing contractor. Moreover, SMUD is very satisfied with the results of their program that trained and certified contractors to promote the program.

Changes in program guidelines, even ones intended to simplify a process, can cause confusion. Keeping program guidelines as consistent as possible, and being prepared to manage confusion when changes are required, is recommended. All of the administrators and several of the participants noted that the changes in the program guidelines, while clarifying, did cause some confusion, especially for those that learned of the program under one set of guidelines, and applied under the changed guidelines. However the changes did simplify the process and likely led to a larger number of participants. The primary focus in such a situation should be to be prepared to address any participant confusion that could arise when changes are required.

Development of a simplified database and enforcing its consistent use would greatly simplify the reporting and MV&E processes. The database developed for this program included numerous data fields that were not used by the administrators. It also lacked reporting abilities that the administrators felt were necessary for internal tracking of projects. Because of these factors, the database was used inconsistently, significantly complicating the analysis of the data it contained.

The potential effects of the accumulation of dirt could have a significant impact, over time, on the effectiveness of the cool roofing materials, and should be investigated. California summers are dry and dusty which leads to the accumulation of reflectivity reducing dirt on roofs. Also this program targeted buildings with flat roofs and, in many cases, it was observed that low spots had led to the pooling of rainwater and a concentrated accumulation of dirt. In these areas the reflectivity could be as much as 30percent less than the rest of the roof. Determining the long-term effect of dirt accumulation will help determine the effectiveness of this and future roofing programs.

The data gathered for the MV&E analysis is a benefit to the program. A considerable amount of information on HVAC systems, roofing material, and reflectivity was gathered during the AB 970 and SB 5X program evaluations. This information could be useful in future studies on the effects of cool roofing projects.